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USE OF OTTAWA ANKLE DECISION RULES TO EVALUATE BLUNT ANKLE  
TRAUMA CASE STUDIES BY UNITED STATES AIR FORCE HEALTH CARE  
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TRAUMA CASE STUDIES BY UNITED STATES AIR FORCE  
HEALTH CARE PROVIDERS"**

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## ABSTRACT

Practice guidelines are developed through a formal process incorporating the best scientific evidence of effectiveness with expert opinions. Clinical guidelines like the Ottawa Ankle Rules (OAR) may serve an increasingly important role within the evolving role of nurse practitioners (NPs) and physician assistants (PAs) within the United States Air Force (USAF) health care model called TRICARE. The OAR have been found to be specific and valid decision rules concerning the common problem of blunt ankle trauma (BAT). Few x-rays for this condition are positive for clinically significant fractures. Use of the OAR by USAF NPs and PAs is unknown. The purpose of this descriptive study was to determine if a sample of NPs and PAs are aware of the OAR. Secondly, what clinical information, tests or rules are used by respondents to correctly determine whether or not to x-ray is warranted in written case BAT scenarios. This study asks if there is a theoretical cost benefit in OAR use? Descriptive data were gathered using case scenarios to measure diagnostic accuracy. Data from 29 respondents indicate lack of awareness of the OAR. There was a 1% difference in accuracy between the 18 NPs and 11 PAs in 11 scenarios. A formula applied to the cases of inaccurately ordered x-rays demonstrated a theoretical cost benefit of \$1,300 to \$3,900. Use of the OAR after a brief education process may improve patient satisfaction, decrease waiting times, and demonstrate cost savings with no increase in rate of missed fractures, or increased provider liability. Use of the OAR may facilitate efficient evaluation of BAT in field conditions.

Keywords: practice guidelines Ottawa ankle rules USAF blunt trauma x-rays cost benefit

**USE OF OTTAWA ANKLE DECISION RULES TO EVALUATE BLUNT ANKLE  
TRAUMA CASE STUDIES BY UNITED STATES AIR FORCE  
HEALTH CARE PROVIDER**

by

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**THESIS**

**Presented to the Graduate School of Nursing Faculty of  
The Uniformed Services University of the Health  
Sciences in Partial Fulfillment of the  
Requirements for the  
Degree of**

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**May, 1999**

## PREFACE

This research was conducted to provide information on the use of the Ottawa ankle decision rules (OAR) by an active-duty sample of United States Air Force nurse practitioners and physician assistants assigned in the continental United States. It was designed to assess respondent's ability to accurately assess whether or not an x-ray was required in multiple, blunt ankle trauma, written case scenarios, and encourage the use of the OAR as part of a thorough, cost-effective assessment process.

## DEDICATION

-I thank The Lord Jesus Christ who has shown me- little things make all the difference.

-To Gina, my loving and understanding wife, I thank God for bringing you to me. I am so happy we're making the trip together- Slow and steady wins the race.

“Without you I am less”- (IOU BIG- Rooster)

-To dad.

-To our children; Luke, Kara, Lori, and Anne; who's favorite phrase:

“It's OK dad, we understand...”

let me know they really did. Without their wind, I'd have never flown

-To Albert, Francis and my patients: “Aspire to know. Go to the facts and examine nature itself- it's all right there. Create in your mind & offer it as a blessing to all”.

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## CHAPTER ONE: INTRODUCTION

### Background

The foot and ankle are the most frequently injured and imaged parts of the body (Prokuski, & Saltzman, 1997; Trevino, Davis, & Hecht, 1994). This hasn't always been true. Kevles (1997) reports that during the first decades of the 20th century, radiological studies were a novelty, a curiosity, and status symbol. Kevles asks us to consider the story of young John Boskirk:

Who in May 1912, was putting awnings on the windows of the post office in Omaha, Nebraska and fell 18 feet to the ground, and was treated for a sprained ankle at a nearby hospital. Seventeen days later, still unable to stand on the hurt foot, a new doctor in charge of his case, Dr. Pinto, suggested that he get an x-ray.

The picture was conclusive- he had a broken bone- and Boskirk sued. At the trial four doctors...testified that "the failure to have an X-ray picture taken as an aid to diagnosis at this time" did not indicate any lack of regular care. Boskirk lost his case. (p. 69)

Radiology is a helpful technology that has assisted health care providers relieve pain and suffering. Some have wondered in the past two and a half decades, if radiologic imaging studies are as important as once thought (Sujitkumar, Hadfield, & Yates, 1986). In this era of health care reform and managed care, authorities currently question the necessity and costs associated with some radiologic studies (Michelson, Ahn, & Magid, 1995; Moloney & Rogers, 1979; Vangsness, Carter, Hunt, Kerr, & Newton, 1994). Helms (1989) reports a significant percentage of all emergency department films are obtained for ankle trauma. Ligamentous injuries can usually be clinically differentiated

from significant fractures. Small bony avulsions receive the same treatment as ligament tears, and are often difficult to differentiate from accessory ossicles. Johnson, Stiell, and Moyer (1997) report 85% of ankle injuries are soft tissue, and highlight the use of the Ottawa Ankle Rules (OAR). Developed by scientists of the Ottawa Civic Hospital (Stiell, Greenberg et al., 1992; Stiell, McDowell et al., 1992), the OAR have proven to be a valid and sensitive set of decision rules. The rules use a standardized diagram of the foot and ankle, and two simple sets of discriminating rules, and include exclusionary criteria (Stiell, McKnight et al., 1994). In most cases the radiologic test (ankle series) previously considered a major determinant of the patient's management could be omitted.

Stover (1980) reports blunt ankle and foot trauma (BAT) are among the most frequently encountered injuries in athletic medicine. Cockshott, Jenkin, and Pui (1983) contend ankle injuries may be been responsible for up to 12% of the patients coming into an emergency room, and many are subjected to radiographic examination of the ankle or foot. Less than 15% of patients with this problem have clinically significant fractures (Stiell, McKnight et al., 1994; Tandeter & Shvarzman, 1997). Jackson and Kroenke (1997) report "the majority of patients have specific expectations for their health care visit and often present with explicit requests" (p. 275). Patients experiencing BAT expect efficient, effective care that minimizes loss of function (Jackson & Kroenke, 1997).

Many patients report to the hospital with pain. Besides pain relief, patients may arrive expecting radiologic tests to determine if their ankle or foot has been fractured. Radiologic tests are often unnecessary, cause treatment delays, and entail a burdensome expense (McBride, 1997). A common practice is to take an ankle film if a patient with a sprain expects it, even though the clinical examination is usually adequate to suggest the

appropriate treatment (Hale, 1996; Hall, 1976; Montague & McQuillan, 1985; Sickles, 1997). Abrams (1979) contended many providers rely on radiologic, rather than clinical, follow-up observation. In the presence of puzzling BAT, the patient (and provider) would like to believe that every possible step is being taken to solve it.

A valid and sensitive clinical practice guideline may assist the provider in deciding in what instance a radiologic exam may be required. Guidelines for the use of radiography in acute ankle injuries were developed in Ottawa, Ontario and presented in 1992 (Stiell, Greenberg, et al., 1992; Tandeter, & Shvartzman, 1997). The OAR have been implemented and validated in large multicenter trials in Canada the United States, and other countries. These decision rules are specific in determining fracture in BAT. The OAR have proven to have a high degree of sensitivity for clinically significant fractures, are easy to use by many providers with varying experience levels, and yield large reductions in the use of ankle radiography (Auleley et al., 1997; Stiell, 1996; Stiell et al., 1993; Stiell, Greenberg et al., 1992; Stiell, McDowell et al., 1992; Stiell, McKnight et al., 1992; Stiell, McKnight, et al., 1994). Anis, Stiell, Stewart, and Laupacis (1995) conclude that widespread use of the OAR would result in significant savings in the United States and Canada without compromising care.

A goal of the USAF Medical Service is to provide responsive and sensitive health care. Using a case scenario approach to examine the clinical decision-making of USAF physician assistants, and nurse practitioners is an appropriate approach to an old problem. Hence, research as this proposal suggests, supports the provision of safe, efficient care in the emerging managed care practice environment. It will determine the extent of the use of the OAR, assist the provider in meeting the patient expectations, protect the highest

standards of care, and has the potential to demonstrate cost savings the USAF health service system.

System changes have recognized the potential of nurse practitioners, predicted by Monninger and Fullerton in 1984. Nurse practitioner practice “extends traditional nursing skills, knowledge, and responsibilities in such a way that this relatively new role of nurses is frequently cited as an important and effective resource for health care” (Monninger, 1988, p. 104). Federal emphasis on health care cost containment has led to greater responsibilities and expanded roles for advanced practice nurses (McLain, 1988). To be acknowledged as powerful resources in health care reform, advanced practice nurses must demonstrate their capability to discern and implement such cost-effective and high-quality care that the OAR offer.

Since 1965, nurse practitioners have demonstrated their capability for success in safe, effective primary health care delivery both autonomously and in a collaborative practice environment (Feldman, Ventura, & Crosby, 1987; Spitzer et al., 1990). Abdellah (1997) reports that “advanced practice nurses do provide competent and efficient health care that has resulted in overall cost savings and better care” (p. 453). Managed care has evolved to be managed costs and now managed competition. Professionals working in the network (TRICARE) must “be ‘valuable’ to the network, implying competency, efficiency, and marketability” (Madden & Ponte, 1994, p. 56).

With the implementation of the Department of Defense TRICARE managed care program a new system of integrated health delivery has begun in the United States Air Force (USAF) health service system. Primary care practice calls for well-developed skills in patient management. The role of the nurse practitioner in managed care

networks is multiple, flexible and based on interventions and outcomes of clinical practice. TRICARE demands a right-sizing of the workforce; models that can utilize non-physician providers to a greater extent to provide beneficiary care (McGee & Hudak, 1995). Mundinger (1994) suggests that a collaborative model may be the best model as it reduces cost while enhancing quality and comprehensiveness. The continued use of non-physician providers will drive the current emphasis on assessment and accountability as it relates to outcomes. Outcome measures should continue to be evaluated because they are practical, available, and/or politically important (Molde & Diers, 1985).

Outcomes have been defined as the five D's: death, disease, disability, discomfort, and dissatisfaction (Lohr, 1988). Satisfaction is unique in that it is an outcome and it may also affect other outcomes such as death, disease, or disability. Patient satisfaction with outcome will have a significant bearing on how treatment modalities are marketed to beneficiary populations. Stone (1994) suggests research exploring interactional processes between nurse practitioners and clients "...needs to be linked to patient outcomes" (p. 17). With the implementation of TRICARE as a capitated health care system, outcome measures will be important in selecting the most cost-effective treatment options while maintaining beneficiary satisfaction (Jackson & Kroenke, 1997). The OAR supports the rationale of patient satisfaction research: cost containment. Providers have at their disposal decision rules. The OAR promotes accurate, timely diagnosis in the instance of BAT; maintain a high standard of care and have a direct, positive influence on satisfaction, and costs associated with care.

### Purpose of the Study/ Problem

Use of the OAR has the potential to promote the best treatment practices in cases of BAT. Use of the OAR has the potential to:

1. save money within the USAF health service system,
2. minimize treatment delays,
3. increase access to care,
4. prevent unnecessary tests,
5. increase patient confidence in non-physician providers,
6. decrease malpractice liability and,
7. provide a cost-effective alternative supporting the highest standards of care.

Therefore, the purpose of the proposed study is to determine if the OAR and/or other clinical information, tests or rules are being utilized by active-duty USAF nurse practitioners (NPs) and physician assistants (PAs) to determine fracture in cases of BAT. With this data, the investigator will extrapolate the potential cost savings of radiologic studies not clinically indicated in each of a number of written case studies presented to volunteers of the study.

In this study, a questionnaire containing case scenarios will be used to determine to what degree, non-physician providers predict fracture. Case scenarios will be developed under a review panel of experts. Blunt ankle trauma case scenarios will contain essential criteria of the OAR will be mailed to randomly selected providers. Findings of this study have the potential to demonstrate rescued fiscal resources to the USAF health service system and demonstrate potential knowledge deficit of health care providers treating BAT.

### Research Questions

Researchers who engage in applied research concentrate on finding a solution to an immediate problem (Polit & Hungler, 1991). The use of case study scenarios will allow a focused look at BAT, and explore the demographics of two groups of non-physician providers in the USAF. The research focus of this study is to determine the need for x-ray in case scenarios of BAT fracture using the Ottawa ankle rules as a clinical practice guideline. Hence, the study asks the following research questions:

1. Are the Ottawa Ankle Rules clinical guidelines being used by a sample of active duty, United States Air Force NPs and PAs?
2. Is there a difference in the selective use of x-rays in case scenarios between NPs and PAs?
3. Is there a theoretical financial benefit to using the Ottawa Ankle Rules?
4. What clinical information, tests, or rules are used to determine if fracture is present in written cases of BAT?

### Conceptual Framework

Some years ago, Albert Einstein said in an address to the California Institute of Technology:

Concern for man himself and his fate must always form the chief interest of all technical endeavors...in order that the creations of our mind shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations. (Curtin, 1988, p. 8)

Health care providers today need to keep abreast of a changing practice environment

including technological advancements, as well as the effects of managed care on their practice. Advanced practice nurses have identified the knowledge base specific to practice and are an expanded role for nurses. There has been a shift, with the development of clinical practice guidelines, that speaks to the benefits of a thorough clinical assessment using what is available within the patient/ provider interaction to relieve patient suffering (Epstein, 1990).

King (as cited in George, 1990) presents an open systems framework and the nursing theory identified as a theory of goal attainment. King's (1981) interest is in the interaction of individuals, human communication and that "90 percent of information used...comes from nonverbal behavior and about 7 percent comes from verbal cues" (p. 71). Central to the use of clinical practice guidelines is having a patient-provider interaction in which to apply the guidelines. Use of clinical guidelines are actions both patient and the advanced practice nurse can count on to reduce the uncertainty inherent in medical practice by defining how to use clinical findings to make predictions on goal attainment in the context of shared treatment decisions (Wasson & Sox, 1996).

Norman Cousins (1981) asks us not to "forget the vaunted miracle cures that abound in the literature of all great religions all say something about the ability of the patient, properly motivated or stimulated, to participate actively in extraordinary reversals of disease and disability" (p. 47). In other words, Cousin stresses that much of human suffering is self-limited and resolves with minimal intervention.

The strength of King's Dynamic Interacting Systems Model (1971) is a theory based, open systems framework that supports an interpersonal system, interacting in an

environment that promotes goal attainment (problem treatment and resolution) (Ackerman, et al., 1989). In this model two individuals come together in a health care situation to develop strategies to maintain a state of health that permits a return to optimal functioning.

King (as cited in George, 1990) identifies the conceptual framework as an open systems framework and the theory as one of goal attainment. In King's model, interaction between client (patient with blunt ankle trauma) and provider (nurse practitioner or physician assistant) is based on the actions of each party within the interaction. This in turn elicits a reaction from each individual in the dyad. Those reactions commingle (interaction) and a transaction, or goal outcome takes place. Her model includes important concepts of a practice model including perception, interpersonal relations, social systems, and health (Walker & Avant, 1988). King's emphasizes the importance of perceptions and the need for the nurse to be alert to both client and provider personal perceptions. This idea of perception is similar to Leininger's emphasis on culture and its effects on the delivery of nursing care (George, 1990). Perceptions within the interaction are an important aspect of the goal-setting interactions between patient and provider.

Though King's focus is on "the nurse", a more practical term health care "provider" will be used for the remainder of the discussion of her conceptual model. The Dynamic Interacting Systems Model (King, 1971) is composed of three interacting systems: (a) personal, (b) interpersonal and, (c) social, in which the individual comprises the inner personal system. Individuals interact to form dyads, triads, and small and large groups, which comprise another type of system called interpersonal systems. Groups with special

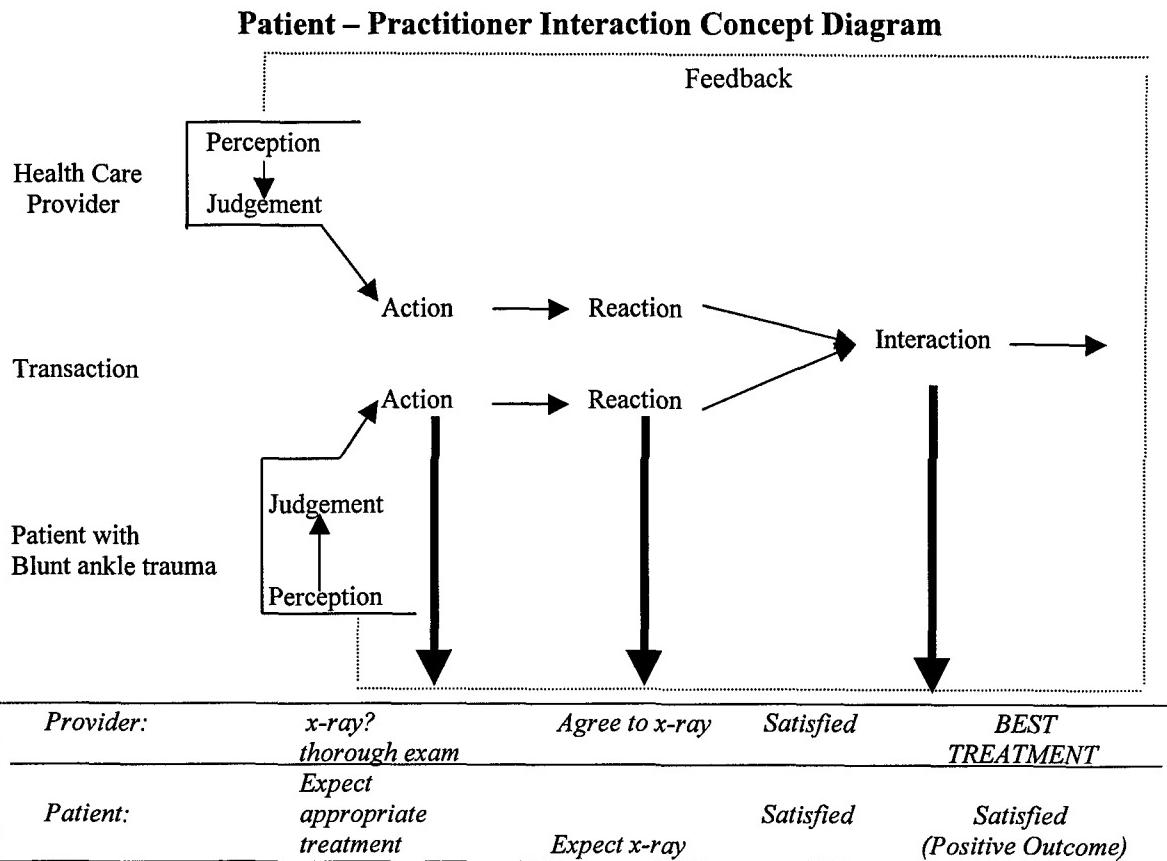
interests and needs form organizations, which make up communities and societies. These groups are called social systems (King, 1981, p. 141).

The relevant concepts of the personal system are perception, self, growth and development, body image, space and time. Perception is action-oriented, is transactional, and suggests perception is a process. An individual obtains data and transforms it. The interpersonal system is the focus of this research. This obvious relationship is formed by human beings interacting. The major concepts of the theory of goal attainment are interaction, communication, transaction role, stress, and growth and development (Ackermann et al., 1989; George, 1990; Meleis, 1991) (See Figure 1, Patient – Practitioner Interaction Concept Diagram).

Nursing as a science historically has “borrowed” non-nursing theory to explore phenomena (Meleis, 1991). Applying King’s (1981) theory to the current study addresses nursing care in the administration of direct patient care and has an application to both nurse practitioners and physician assistants. King addresses the four major concepts central to nursing theory. If a provider is to help the BAT patient, he or she should consider more than just the question of “is the ankle is fractured or not?” What perceptions do the patient and provider bring to the interaction? Why is the patient seeking care and what expectations does the patient bring to the interaction? As a provider, what is the standard of care for individuals seeking care with similar symptoms of pain, tenderness at a specific site on the body (health, environment/society)? Finally, what can the provider do to satisfy the patient’s needs relating to pain and altered functioning?

King (1981) feels nurses (providers) have a responsibility to educate and share

information (the Ottawa Ankle Rules) that helps individuals make informed choices about health care. Further, King says "nurses are concerned with human beings, interacting with their environment in ways that lead to self-fulfillment and to



**Figure 1.**

Patient – Practitioner Interaction Concept Diagram. Adapted from J.B. George, Nursing Theories: The Basis for Professional Nursing Practice, Imogene M. King, Englewood Cliffs, NJ: Prentice-Hall, 1990, p. 200.

maintenance of health" (p. 49). King presents an open systems framework from which she has derived a theory of goal attainment. The three sub-systems of the model

(personal, interpersonal, and social) are all in continuous exchange with their environment. From this open systems framework King has derived a theory of goal attainment. The three sub-systems of the model are all in continuous exchange with their environment. They may function optimally in their roles.

King (1981) believes a goal of providers is to help individuals improve their health so they may function optimally in their roles. In order for goals to be attained, it is important that the provider and patient perceive each other, the situation, and communicate information. If this does not occur, transactions are not made, and goals cannot be achieved. Practice guidelines support the relationship and promote optimal patient care. Developed and proven guidelines and decision rules are standards of care that assist the provider in providing efficient, safe and effective care (Ellwood, 1988; Weingarten, 1997).

Since the 1980s, an important development in American medicine has been the role of clinical practice guidelines, or prediction rules. Clinical prediction rules specify for providers the proper indications for performing medical procedures and treatments and the proper management of specific clinical problems. Clinical rules “are intended to help physicians interpret clinical information” (Wasson, Sox, Neff, & Goldman, 1985, p. 793). Medicine has entered an era of unprecedented growth in activity directed at the assessment of outcomes, the analysis of effectiveness, and quality assurance measures. Clinical practice guidelines are an important innovation to improve the quality of care by defining appropriate clinical practice (Sox & Woolf, 1993). Paul Elwood (1988), who popularized the concept of health maintenance organizations, has called for a major

initiative in what he terms “outcomes management”— a national program in which clinical standards and guidelines are based systematically on patient outcomes.

In 1990, in line with this notion, the federal government, through the Agency for Health Care Policy and Research, launched a program directed at developing guidelines for medical practice through the assessment of patient outcomes (Epstein, 1990). Greco and Eisenberg (1993) report clinical practice guidelines have gained popularity as a means of influencing “physicians’ practices” (p. 1271) but add that physicians are upset due to the intrusion of external constraints (like guidelines). To be effective, guidelines must be used. They are currently used increasingly in practice and “since hundreds of practice guidelines are anticipated in the coming years, family physicians should become informed consumers of guidelines, avoid accepting them on face value, and ask specific questions to judge their quality” (Woolf, 1995, p. 1455).

The treatment providers apply in cases of BAT involve subjective and objective elements. Each element is essential in the decision whether or not to x-ray in cases of BAT. The objective element consists of weighing potential outcomes, benefits and harms of the various options, and determining how likely each is to occur. Doing so requires adequate training to understand options and having a command of the current data on the magnitude or probability of potential benefits and harms. This task is made easier through the use of the Ottawa Ankle Rules.

In congress with the patient, the provider must decide whether or not to obtain a x-ray in cases of BAT. Some patients dislike ambiguity when it comes to their medical care (Woolf, 1997). McLain (1988) says “Nursing is a profession equipped with the interest in and skill for creating environments conducive to open communication” (p. 38).

Creating a provider-patient partnership has been shown to improve patient satisfaction and compliance in psychiatry, the social sciences, and in primary care (Molde & Diers, 1985). Woolf (1997) reports the long tradition of medical paternalism must now be tempered with the notion of allowing patients to express their wishes for treatment and shared decision-making. The OAR support a shared experience and a discussion of goals; the provider is able to discuss with the patient why or why not a radiologic study is required. The OAR do not discount patient feelings or support the notion of "cookbook medicine". The patient enters the interaction, in partnership with the provider, often with the expectation of pain relief and to rule out fracture. Using a decision rule like the OAR clinical guidelines supports the clinical diagnosis and the use of further diagnostic study. Providers dissatisfied with the practice of medicine because of constraints on practice need not worry about the intrusiveness of the OAR. The Ottawa Ankle Rules are intended to assist the clinician in the formulation of an accurate diagnosis.

The necessity of accurate assessment and accountability are part of a safe standard of care. The OAR produce more rational, logical, and efficient care. Clinical guidelines like the OAR should replace the "defensive x-ray examinations" which have been estimated to be used in 30% of all cases where x-rays were obtained (Abrams, 1979, p. 1214). Hale (1996) supports the use of defensive medicine by saying "anyone who has been in practice for a while knows that the reason we take these x-rays is legal, not medical" (p. 363). Joshi (1995) reports that "In this decade of increasing litigation, many clinicians faced with acute ankle and foot trauma automatically take radiographs in search of occult fractures" (p. 152). This practice raises costs and causes substantial delays in care. Another study went so far as to extrapolate legal costs for missed fracture

litigation (Anis et al., 1995). Use of the OAR as a clinical guideline, helps to ensure the provider is protected against charges of malpractice.

Clinicians always face missing a clinical clue and confronting a malpractice suit.

Brand and colleagues (1982) note:

A physician who fails to obtain an x-ray examination out of carelessness could be held negligent if harm resulted, but omission of an x-ray study on the basis of selectivity in ordering diagnostic tests is not negligent, provided that the doctor's decision is consistent with the patient's clinical presentation.

A physician cannot be found liable for an incorrect diagnosis unless the patient suffers damage as a result. (p. 338)

Collaborative implementation of these decision rules in cases of BAT by a variety of providers can only enhance the effectiveness and success of the primary care of patients entering the USAF health service system.

Health care is a service industry. As providers in this industry, advanced practice nurses are caregivers to individuals (or individuals and their families). Their primary focus will be in ensuring patients receive the care they need (Gebbie, 1997). Cost is a necessary factor in health care delivery, but it should not be the sole indicator in outcome management. In today's world of cost-conscious medicine, however, it may be useful to evaluate ankle injuries according to the Ottawa Ankle Rules (Wexler, 1998). Obtaining high-yield x-rays at the proper time through the use of the OAR may in theory save money for the USAF health service system.

It has been estimated that ankle x-rays cost an estimated 500 million dollars in the United States (US) and Canada (Anis et al. 1995; Stiell, 1996). Michelson et al. (1995)

report that reducing follow-up x-rays in cases of ankle fracture could save over 35 million dollars in the US per year. Anis et al. (1995) report the use of the OAR could result in US savings of \$7.45 to \$32.92 which varied according to the rate of missed fractures, costs of radiography, probability of lawsuits, and costs of lawsuits (p. 442). The British Columbia Medical Association (1998) reports that the OAR could reduce the number of annual ankle x-rays by 20% (<http://www.hlth.gov.bc>). A multicenter trial in Ontario, Canada (Stiell et al., 1995) reports use of the OAR decreased appropriate x-ray use by 26%. One must also consider the indirect cost of BAT. Rigler (1976) says "once a radiograph has been made, regardless of how unnecessary...it must be examined and interpreted...this may happen several times" (p. 449). Studies demonstrate patients with no radiography spent less time in the emergency department and had lower medical charges (Stiell et al., 1995; Stiell, McKnight, et al., 1994). For this study, cases of inappropriate x-ray decision will be divided into total possible cases of x-rays, then multiplied by the average cost of an x-ray (or series) to achieve a theoretical cost savings.

#### Conceptual and Operational Definitions

For the purpose of this study, the following definitions will be used:

##### Health Care Providers.

All physician assistants (PA) and all nurse practitioners (NP) in active duty service in the United States Air Force.

##### Blunt Ankle Trauma (BAT) Cases.

Written cases, reviewed by a panel of experts, containing specific clinical criteria of the Ottawa Ankle Rules. Blunt ankle trauma can occur through a variety of mechanisms but typically results in forced inversion of the foot; forced dorsiflexion of the foot, or

external rotation and abduction. This mechanical motion may result in a simple sprain or may be as serious as a clinically significant fracture (Rizzolo, 1993; Sickles, 1997).

Clinical Practice Guideline.

An official statement that outlines how to prevent, diagnose and/or treat specific medical conditions and how to perform certain clinical procedures, often used as an adjunct to sound clinical judgement. Clinical practice guidelines are also known as practice parameters, clinical policies, standards, treatment protocols, appropriateness criteria and other closely related terms. They are intended to help clinicians interpret clinical information (Wasson, Sox, Neff, & Goldman, 1985; Weingarten, 1997; Woolf, 1995).

Ottawa Ankle Rules (Guidelines For Radiography of the Ankle and Foot).

A set of systematically developed rules to assist a health care provider determine the use of radiography in ankle or foot injury (Stiell, McKnight, et al., 1994).

The Ottawa Ankle Rules do not apply in cases of: Persons less than 18 years of age, intoxication, multiple painful injuries, pregnancy, head injury, or diminished sensation due to neurological deficit. The Ottawa Ankle Rules provide recommendations where a careful assessment shows blunt ankle trauma, or twisted ankle:

1. Ankle x-rays are required if there is any pain in the malleolar zone, and any one of these findings:
  - Bone tenderness along the distal 6 centimeters (cm) of the posterior edge of the fibula or tip of the lateral malleolus.
  - Bone tenderness along the distal 6 cm along the posterior edge of the tibia or tip of the medial malleolus.

- Inability to bear weight for four steps both immediately and in the emergency department (within the first hour following the injury).

2. Foot X-rays are only required if there is any pain in the midfoot zone, and any one of these findings:

- Bone tenderness over the navicular
- Bone tenderness over the base of the 5th metatarsal
- Inability to bear weight for four steps both immediately and in the emergency department (within the first hour following the injury).

#### Assumptions and Limitations

The OAR have been validated and found to be specific for fracture in events of BAT. The Ottawa Ankle Rules Project presented by Stiell(1996) demonstrated that more than 95% of patients with ankle injuries had x-rays, but that 85% of the films showed no fracture. Refinement and validation have shown the OAR to be 100 % sensitive for fracture; to be reliable, and to have the potential to allow providers to safely reduce the number of radiographs ordered in patients with ankle injuries (Stiell et al., 1993). The primary assumption is that clinicians are unaware of the OAR and use other non-specific clinical data to determine if fracture is present.

A sample of non-physician providers may demonstrate clinical differences in their abilities in determining fracture. Nurse practitioners and physician assistants receive varying levels of formal education, and differences exist in preparation and practical experience. Non-physician providers are being utilized with increasing frequency in the USAF health service system. By examining two groups (nurse practitioners and

physician assistants), comparisons can be made between the two groups, comparing how each individual within that group assesses BAT. Then each group as a whole can be compared as to their ability to assess BAT using a descriptive design, case study scenario approach.

This study was limited by constraints of time and fiscal resources. The researcher is enrolled in full-time graduate study and as such, this study in part fulfills the requirements of a master of science in nursing. The goal was to have a large enough sample to determine significance, but not large enough to be prohibitive in terms of cost or time. Statistical support and software was available to the researcher and was adequate to implement this research.

#### Summary

Ankle injuries are frequent, as are the radiologic tests accompanying their assessment. In most instances, x-rays are done on ankles without fracture, for a variety of reasons; exposing the system to excessive costs, time delays, and patient dissatisfaction with outcomes. The OAR is an example of clinical practice guidelines that are beneficial in some populations. This study proposes to answer research questions using case scenarios relevant to the OAR. King provides a suitable framework to evaluate adherence to practice guidelines.

## CHAPTER TWO: LITERATURE REVIEW

### History and Physical Anatomy

Since the time of Hippocrates, lesions of the ankle were diagnosed chiefly as luxations. In the eighteenth century French and English clinical literature called attention to the serious nature of ankle lesions and the difficulty in treatment. Most ankle treatments at that time invariably led to varying degrees of disability. It was not until the early 20th century soon after the introduction of x-rays (then "roentgenogram") in clinical work, that fractures of the ankle were interpreted as a form of primary injury in serious cases of lesions of the ankle (Lauge, 1948).

Ankle injuries are described according to anatomic descriptions such as, medial malleolar fracture, lateral malleolar fracture, bimalleolar fracture, etc., "However, appreciating the mechanism of injury allows one to anticipate unexpected pathology, i.e., the possibility of ligamentous injury or fracture not otherwise apparent on x-ray" (Dias, & Foerster, 1974, p. 219). Classifying ankle injury is an important part of the diagnostic process "for without classification, the relation of one lesion to another can be neither remembered nor understood in any department of knowledge; comprehension is a prerequisite for intelligent memory and for rational diagnosis and treatment" (p. 219). Sprains are one of the most common injuries seen by primary care physicians (Sickles, 1997). Bearing this thought in mind, how does a provider differentiate fracture, sprain, or an unstable ankle mortise joint based on either of these conditions? The answer lies in a thorough history including the mechanism of injury and a complete physical exam of the ankle and foot.

Functionally, the foot can be compared to the pronated hand. The soft structures of the hand and foot are similar in many details, and the bony structure is fundamentally similar, but modified in the foot because of its weight-bearing duties. The primary function of the foot is to provide a stable platform of support to attenuate impact loading of the extremity during locomotion, and to assist in the efficient forward propulsion of the body (Gross, Fetto, & Rosen, 1996). Structural integrity of the foot is dependent on the combination of articular geometry and soft-tissue support (Gross et al, 1996; Stover, 1980). To manage these functions, the foot bone has 26 bones. The talus bone (ankle bone) is the only bony link between the leg and the foot.

Rizzolo (1993) provides a thorough description of the functional anatomy of the complex structure of the ankle, formed by three bones and two groups of ligaments. The distal end of the tibia and fibula form into an arch into which the talus articulates (the mortise). Collateral ligaments stabilize the joint, preventing eversion and inversion while allowing plantar flexion and dorsiflexion. Tendons loosely provide secondary support. The external (lateral) collateral ligament (LCL) consists of three separate elemental ligaments. The LCL's are relatively lax and allow for considerable internal rotation of the foot and are the most commonly affected in ankle injury as the result of forceful inversion. The medial (deltoid) ligaments of the ankle joint are taut, and allow much less motion than do the lateral ligaments. The motion of the ankle joint includes flexion-extension and anterior-posterior glide. Due to the complexities of the synovial articulations within the structure of ankle, the ankle is generally considered the most commonly injured joint and a frequent cause of morbidity in the general population (Prokuski, & Saltzman, 1997; Sujitkumar et al., 1986; Wexler, 1998).

When getting a history it is important to elucidate the mechanism of injury.

Discovery of the injury mechanism allows the clinician to hunt for suspect lesions in an anatomic zone. Observe how the individual walks (limps?) into the exam area. A thorough examination includes inspection, bony and soft tissue palpation, neurologic evaluation, tests for joint stability, range of motion (ROM) and any other additional special tests (Hoppenfield, 1976). The patient should be inspected in a sitting, non-weight-bearing position, as well as standing and walking (if tolerated). Both feet and ankles should be examined. The toes should point straight forward and lie flat. Normally the skin is smooth; shiny over either malleoli. There should be a longitudinal arch, but flat feet are a normal variant. The transverse arch of the foot is located immediately behind the metatarsal heads (Hoppenfield, 1976). The joint spaces of the ankle should be smooth and depressed, with no fullness, welling, or tenderness (Jarvis, 1996).

The basic ankle and foot motions are: (a) ankle motions of dorsiflexion and plantar flexion, (b) subtalar motion of inversion and eversion, (c) midtarsal motion of forefoot adduction and abduction and, (d) toe motion of flexion and extension (Hoppenfield, 1976). Normal ROM should include: (a) dorsiflexion ~20 degrees, (b) plantar flexion~45 degrees, (c) inversion ~30 degrees, and (d ) eversion ~20 degrees. According to Jarvis (1996) examine the patient for limited ROM or pain with motion. Observe the patient by noting the response to specific commands (p. 679) (See Table 1).

Range of motion can be inhibited giving the clinician clues as to the cause of the loss of function. Fore, aft, or side-to-side motion may be restricted due to swelling, which restricts ROM. Limited dorsiflexion may be due to intermalleolar narrowing (The wider portion of the talar head will not fit into the mortise).

Tests for ankle joint stability in cases of blunt ankle trauma (BAT), should include the anterior drawer test, talar tilt testing and a full ROM series examining the relative laxity of the joint (Hoppenfield, 1976). A thorough exam, including the use of the

Table 1

Patient Instruction and Expected Movement

| <u>Patient Instruction</u>  | <u>Motion and Expected Range</u>                              |
|---|---|
| Point toes toward the floor   | Plantar flexion of 45 degrees                                 |
| Point toes toward your nose   | Dorsiflexion of 20 degrees                                    |
| Turn soles of feet out, then in (stabilize the ankle with one hand, hold heel with the other to test the subtalar joint). | Eversion of 20 degrees<br>Inversion of 30 degrees             |
| Flex and straighten toes.   | Maintain dorsiflexion and plantar flexion against resistance. |

Adapted from: S. Hoppenfield, Physical Examination of the Spine & Extremities, Norwalk, CT: Appleton & Lange, 1976, pp. 223-226; C. Jarvis, Physical Examination and Health Assessment, Philadelphia: W.B. Saunders, 1996, pp. 678-679.

Ottawa Ankle Rules (OAR), will assist the clinician in making a determination as to the functional status of the ankle mortise and foot. A complete exam directs the plan for action and treatment plan.

### Clinical Decision Rules - When to Get an X-ray

The ankle ranks with the knee and shoulder, among the three anatomic regions most commonly injured (Daffner, 1994; Sickles, 1997; Stover, 1980). Most ankle injuries can be treated in the office, although more serious injuries should be referred to an orthopedic service (Wexler, 1998). Sprains of the ankle are common injuries, and the major ankle problem treated by most primary care practitioners. Ankle x-rays account for about 2-3% of all radiologic examinations and about 10% of those performed in emergency rooms (Sujitkumar et al., 1986; Tandeter & Shvartzman, 1997; Trevino et al., 1994). Significant is the fact that less than 15% of ankle injuries are found to result in significant fracture (Stiell, McKnight, et al., 1992; Tandeter & Shvartzman, 1997; Vargish, Clarke, Young, & Jensen, 1983; Wexler, 1998). Trevino and colleagues (1994) report the incidence of inversion injuries is estimated at 1 per 10,000 persons, per day. Frykberg (1996) states that "lateral ankle sprains of the lateral collateral ligaments are the usual presentation, since medial sprains of the deltoid ligament are frequently accompanied by lateral ankle fractures" (p. 1078).

Because of the variety of ankle injuries, practitioners need a valid tool to assist in the decision whether or not to obtain an x-ray. Tandeter and Shvartzman (1997) write that fractures may be associated with severe ligament injuries, but avulsion can happen before a "ligament is torn . . . Physicians usually consider it mandatory to obtain a radiograph of every injured ankle even though the vast majority of these films show no evidence of significant bone injury" (pp. 2272, 2274-2275).

The routine use (overuse) of ankle radiographs is debatable (Abrams, 1979; Montague & McQuillan, 1985; Stiell, 1996; Stiell, McDowell, et al., 1992; Verma et al.

1997; Wexler, 1998). Rizzolo (1993) suggests that the uses of x-rays are not necessary for most ankle injuries. Clinical observation and treatment of blunt ankle and foot injuries leading to discovery of significant fracture have led to the development of objective screening guidelines for the prediction of fractures. As part of the interaction between provider and patient, the provider would find it helpful to have some guideline to direct when to x-ray in cases of BAT.

Clinical variables have been studied for the prediction of fractures versus soft tissue injuries of the ankle. DeLacey and Bradbrooke (1979) retrospectively reviewed x-ray films, casualty cards and notes of 100 consecutive patients in the accident department of a British hospital. Their study was based on earlier work that suggested the simple maxim “no swelling adjacent to a malleolus, no radiographs”(p. 1597). DeLacey and Bradbrooke found 65% of ankle injuries without swelling did not have fracture, and 99% (92 of 93) patients with a major fracture, had soft tissue swelling at the level of the malleoli. In 32% of all cases (100), ankle radiographs had been performed, but only 3 foot injuries were found. To summarize, local swelling and point tenderness are valid high-yield criteria for the presence of fractures in injured ankles. The authors concluded, “a radiograph will not be helpful in an adult who presents with an acute ankle injury and has no swelling specifically adjacent to either malleolus” (p. 1598).

Brand et al. (1983) developed one of the first documented protocols for use in injured extremities, of which the evaluation of the ankle was included. The developed protocol only missed one in 287 fractures. Eight hundred sixty four patients were seen during the first two years of the 4-year, two-phase study (protocol development and then evaluation). Clinical discriminators were identified, and a step-wise procedure ( $\chi^2$ ,

p=0.05) using Chi-square statistics led to combining variables ended when inclusion of a variable failed to improve predictive accuracy. The developed protocol was tested the next two years. The results of the study attested to the safety of using a protocol in conjunction with careful physical examination. The study demonstrated that it is possible to reduce the use of radiography while maintaining a high standard of quality and safety.

Recognizing x-ray was rapidly superseding clinical examination in cases of ankle injury, Vargish et al. (1983) developed a working list of clinical indicators to assist in the differentiation of soft tissue injury versus fracture. Over a brief period, 150 patients of a convenient sample (no institution mentioned) were examined using an assessment form. Chi-square analysis (p=0.05) was performed on each variable. Of the 150 patients assessed in the study, nineteen (12.7%) had fractures and one hundred thirty one (87%) had soft tissue injuries. The patient's ability to bear weight and the presence of point tenderness over the lateral aspect of the ankle below the malleolus proved to be "helpful" clinical points. This study also suggested that careful patient assessment permitted the discriminate use of ankle x-rays. The work of DeLacey and Bradbrooke (1979), combined with Vargish and colleagues (1983) proved to be the basis of what came to be known as the Ottawa Ankle Rules (OAR).

#### Ottawa Ankle Rules

Work such as previously noted continued into the 1990's (Cocksott et al., 1983; Dunlop, Beattie, White, Raab, & Doull, 1986; Gleadhill, Thomson, & Simms, 1987; Matthews, 1986; Sujitkumar et al., 1986; Warren, & Ferguson, 1984). Stiell, McDowell and colleagues (1992) presented a two-stage study examining the attitudes and judgements of experienced clinicians in their use of ankle radiography and to assess the

potential for improved efficiency. The findings of this original research suggested “great potential for a more efficient use of radiography in patients with ankle injury...through the use of guidelines” (p. 1671), later referred to as the Ottawa Ankle Rules. The OAR are a set of decision rules to determine if an x-ray is needed in the case of non-pregnant adults who have experienced BAT. It includes a standardized picture (Stiell, McKnight, et al., 1994) of the foot and ankle with a malleolar zone and a midfoot zone. Based on this picture the rules are listed below:

An ankle x-ray series is only required if there is any pain in malleolar zone and any of these findings:

1. Bone tenderness at the posterior edge or tip of lateral malleolus (3 centimeters [cm] proximal and/or distal), or
2. Bone tenderness at posterior edge or tip of medial malleolus (3 cm proximal and/or distal), or
3. Inability to bear weight both immediately and in the emergency department.

A foot x-ray series is only required if there is any pain in midfoot zone and any of these finding:

1. Bone tenderness at the base of the 5th metatarsal, or
  2. Bone tenderness at the navicular bone, or
  3. Inability to bear weight both immediately and in emergency department.
- (p. 828).

These guidelines were further used to conduct a prospective study of patients presenting with BAT in the ED's of two Canadian university hospitals. The study was conducted in 1990 over a period of six months. In the study (Stiell, Greenberg et al.,

1992), 32 clinical variables were assessed and recorded on data sheets prior to radiography. Variables were measured for reliability and association with significant fracture on both ankle and foot radiograph series. The results of the main study concluded the OAR were 100% sensitive and 40% specific for malleolar fractures and, if used, would reduce ankle x-rays 36%. All 32 midfoot fractures were identified through the use of the OAR.

Stiell, McKnight and colleagues (1994) reported on the successful implementation of the OAR in a nonrandomized, controlled trial comparing rates of ankle and foot x-ray series before and after intervention. All adult patients reporting to two Canadian university hospitals with acute blunt ankle trauma were included in this study of 2,342 patients. Persons completing the data form included experienced physicians as well as house officers. One hospital served as control and the intervention hospital used the OAR. This study revealed a reduction at the intervention hospital in the number of x-rays, time of treatment and total costs associated with treatment. Patient satisfaction with services did not change significantly. Ottawa Ankle Rule sensitivities were 1.0 (reported as 95% confidence interval- or .95 to 1) for malleolar fractures (74 total), and 1.0 for detecting 19 midfoot fractures. Conclusions of this large study suggest implementation of the OAR led to decrease in radiography, waiting times, and costs without patient dissatisfaction or missed fractures. The OAR have subsequently been tested and found to be highly sensitive and reliable measures of the likelihood of significant fracture. The OAR are better at predicting the need for x-ray than clinical suspicion alone, in cases of BAT in non-pregnant adults (Lucchesi, Jackson, Peacock, Cerasani, & Swor, 1995; Stiell et al., 1993) (see Table 2, Studies Using the Ottawa Ankle Rules to Predict Fracture).

**Table 2**Studies Using the Ottawa Ankle Rules to Predict Fracture

| Author(s)  | # of Cases | Sensitivity |       |       | Specificity |       |       |
|--|------------|-------------|-------|-------|-------------|-------|-------|
|  |            | Ankle       | Both  | Foot  | Ankle       | Both  | Foot  |
| Pigman et al. (1994)-USA<br>*OAR reduced x-rays 19%  | 110        |             | 1.0   |       |             | 0.19  |       |
| Lucchesi et al. (1995)-USA   | 484        | 0.946       |       | 0.931 | 0.155       |       | 0.115 |
| Auleley et al. (1997)-France<br>*OAR reduced x-rays 22.4%  | 4,980      |             |       |       |             |       |       |
| McBride (1997)-Canada<br>*OAR could reduce x-rays by 26.3%   | 296        |             | 0.971 |       |             | 0.302 |       |
| Verma et al. (1997)-USA<br>*OAR reduced x-rays by 16%  | 926        |             | 0.99  |       |             | 0.22  |       |
| Salt et al. (1997)-England<br>- 238 (73%) received nurse-requested x-ray: 20% had fractures.<br>- Of the remaining 86, 19 had x-rays (per MD) and no fracture was detected.<br>- 67 with no x-ray ordered returned in the subsequent eight weeks.<br>- Concluded nurses can apply OAR safely without missing acute fractures | 324        |             |       |       |             |       |       |

**Clinical Practice Guidelines**

Guidelines are popular. The definition of "guideline" has been expanded to mean many kinds of guidance. The definition should be narrowed to include only rules about

when to initiate and/or when to avoid medical interventions (tests, treatments, and other actions) that are valid and decidable within specified medical contexts (McDonald & Overhage, 1994). By this definition, prediction rules designed to decide when to intervene are guidelines. Research-based rules are essential in the development of clinical guidelines (Duff, Kitson, Seers, & Humphris, 1996). Clinical guidelines are serving an increasingly important role within evolving health care systems and it's been suggested guidelines serve as educational tools (James, Cowan, Graham, & Majeroni, 1997). Though providers may fear the intrusion of practice guidelines, the major impetus for development of guidelines is to improve the quality of care provided to patients (Greco & Eisenberg, 1993; James et al., 1997; Weingarten, 1976).

A growing number of agencies (the USAF health service included) are developing clinical practice guidelines that outline the proper care of medical conditions (Epstein, 1990; Woolf, 1992). It is difficult for practice guidelines to define optimal care (Woolf, 1995), however the OAR are based on empirical research, do not use rigid language to describe "right" or "wrong" treatment and recognize the individual and the need for a thorough history and physical assessment in each case of BAT.

In outcomes management there are critical factors involved (Epstein, 1990). Use of the OAR and clinical practice guidelines in general supports the fiscally competitive nature of a changing health care market. A capitated market encourages cost considerations and acknowledgment of patient satisfaction as an outcome measure (or patients will go elsewhere for care). Costs decrease with a reduction in x-ray use in cases of BAT. Use of the OAR ensures the best patient practices are done at the right time. Since 1970, health maintenance organizations have grown 20-fold, renewing the sense of

competition in health care. TRICARE, as a managed care option plan, has introduced competition into the military medicine environment. Rules and guidelines that promote efficient, safe, and effective use of resources can improve patient outcomes.

### Summary

Since antiquity, there has been medical interest in how best to treat ankle injuries. The OAR are prediction rules that decide when to intervene, and as such are guidelines assisting the provider in making the decision whether or not to x-ray. The ankle joint and feet are complex structures serving important functions. The development, testing and validation of the OAR has demonstrated the rules to have a part of the thorough physical exam of the patient who has recently experienced BAT. More than one authority has suggested x-rays are not necessary for most ankle injuries. The OAR are valid, reliable measures of the need to get an ankle x-ray. The use of the Ottawa Ankle rules in the setting of United States Air Force medical care is unknown. The use of the OAR could prove of benefit to the Air Force Medical Service as it initiates TRICARE by decreasing: (a) time spent in treatment, (b) number of x-rays, and (c) costs in treating BAT.

### CHAPTER THREE: METHODS

The purpose of this study was to determine if the Ottawa Ankle Rules (OAR) and/or other clinical information, tests or rules are being utilized by active-duty United States Air Force (USAF) nurse practitioners (NPs) and physician assistants (PAs) to determine fracture in cases of blunt ankle trauma (BAT). This chapter describes the methodology of the study: the research design, sample, measurement, protection of human rights, and describes the plan for data analysis.

The following research questions were addressed: (a) Are the Ottawa Ankle Rules clinical guidelines being used by a sample of active-duty USAF NPs and PAs? (b) Is there a difference in the selective use of x-rays in case scenarios between NPs and PAs? (c) Is there a theoretical financial benefit to using the Ottawa Ankle Rules? (d) What clinical information, tests, or rules are used to determine if fracture is present in blunt ankle trauma?

#### Research Design and Procedures

This study was essentially descriptive in design. It consisted of a mailed questionnaire (Appendix A) that gathered demographic data and described the participant's practice setting, and clinical experience. On 4 October, 1998 following the Uniformed Services University of the Health Sciences Institutional Review Board approval and receipt of a USAF control number, an initial mailing of adequate size was mailed to the individual address of each participant selected by roster. The mailer included an explanatory consent letter (Appendix H), a copy of the instrument, and a self-addressed, postage-paid envelope (4 1/8 x 9 1/2 inches- all purpose, white for office use) for return. Forty-five days was allowed for an adequate response period. A follow-up

postcard to the same addressees were mailed to ensure adequate return rates. A second mailing was not necessary. One respondent telephoned requesting a duplicate questionnaire. The returns were addressed to the researcher's university mailbox to minimize handling error.

#### Sample

Participants were selected from a mailing list, obtained from the USAF personnel office, using a random selection process. A single, inclusive list of CONUS-assigned, USAF NPs and PAs was utilized. All eligible NPs were selected (Primary, Adult, and Family Air Force Specialty Codes [AFSCs]). A second PA mailing list was randomly drawn to equal size to the NP mail list. Only General duty PAs were considered. Members within each group had equal opportunity at selection.

By a September 1997 report there were 31 NPs with AFSCs appropriate for consideration in this study (Maj. S. Hall, personal communication, 20 April, 1998). This number does not include pediatric nurse practitioners, women's health nurse practitioners, midwives or nurse anesthetists. The criteria for PAs included active duty PAs (biomedical clinician) currently assigned against USAF specialty codes described as general physician assistant. Initial numbers of total PAs as of 15 April, 1998 was 427 (S. Hall, personal communication, 14 April 1998). For USAF security reasons, the investigator was unable to differentiate PAs by specialty work areas. Hence the population list included PAs in the specialties of otolaryngology, perfusion, and orthopedics. These PA specialties were excluded.

When planning a study one determines the desired power, acceptable significance

level, and expected effect size and uses these three parameters to determine the necessary sample size (Munro & Page, 1993). The sample size from each group was 28 for a total mailing of 58. An anticipated return rate of 50% would yield a sample size of approximately 28. A sample size of 27 is needed for an alpha level of .05 (two-tail) with effect size of medium to large (E. Levine, personal communication, 14 April, 1998). The receipt of 29 respondents was a sample large enough to be representative, but small enough to contain costs.

#### Measurement

A researcher-developed instrument was used in this study (Appendix A). Permission was obtained (Appendix G), and components of the OAR were used for the written case scenarios that became part of the instrument. Following a portion for demographic data, participants were asked to select YES or NO to Is an ankle x-ray required? for each of 11 case scenarios. Case studies were unidirectional (positive or negative) and have one correct response (in six cases YES, and five cases NO). Cases were mixed but not randomized on the questionnaire. Data retrieved from the returned instruments were grouped, analyzed, and presented using statistical software available to the investigator.

The instrument underwent review by a panel of two individuals recognized as experts in the area of concern. Both were medical physicians and held specialty certifications in emergency medicine. Each had experience using the OAR for at least the last 3 years. Both had been in practice at least 5 years, and had extensive experience treating ankle injuries in the primary care or emergent setting. Both were appropriately-licensed providers according to federal, province or state regulations. A review form was provided to each evaluator. This review form included a Likert-type scale for each expert

to rate the case scenarios. Each reviewer was also asked to comment on the readability of the instrument. The scaled items will be numerated and averaged on a 1-4 scale (1-not related, 2-slightly unrelated, 3-slightly related, and 4-very related) for applicability to the OAR.

Validity pertains to the extent to which the tool actually reflects the problem being measured. Content validity of the created instrument was accomplished through use of the expert panel as noted above. Members were selected based on criteria and referral. A numeric value, reflecting the level of content-related validity, was measured using a content validity index described by Waltz and Bausell (as cited in Burns & Grove, 1997). This study goal was a content validity of  $\geq 0.80$ . The instrument yielded a content validity index of 0.93, providing supporting evidence for the validity of the tool. As mentioned, the experts commented on readability of the instrument, an essential element of the validity and reliability of the instrument.

#### Protection of Human Subjects

Participation in this study was completely voluntary. A cover letter was included with the instrument that explained the purpose of the study and that completion of the survey implied informed consent. The study received approval from the thesis committee and the Institutional Review Board at the USUHS (Appendix C). A survey control number was obtained from the pertinent USAF office (Appendix D). To ensure confidentiality, the returned questionnaires did not contain identifying information. The investigator had sole roster custody. Participants withdraw from the study by not returning the questionnaire. Participation involved no apparent risk to a patient population or the respondents. There were no direct benefits to participants, who donated

time to participate. Indirect benefits may be obtained in consideration of the potential educational benefit of the study. Returned, completed questionnaires were secured. The investigator had sole access to the completed questionnaires.

#### Plan for Data Analysis

Variables were coded (Appendix B) for computerized data entry and analysis. The Statistical Packages for the Social Sciences (SPSS) Graduate Pack 8.0 for Windows (1997) computer program, was used in part to generate statistics that summarized quantities of descriptive data into meaningful frequency distributions, measuring variability, and interpreting raw data of *yes* or *no* responses into percentages. The ability to accurately select whether or not to order an x-ray is required in case scenarios of BAT between NPs and PAs was compared. Descriptive and demographic data concerning the sample were presented in cross tab format. A theoretical cost benefit is represented using a formula based on x-rays inaccurately ordered: Total of inaccurately-ordered x-rays for all respondents, multiplied by the average dollar cost of a single x-ray.

#### Summary

This descriptive study was designed to gain more information about NPs, PAs and their use/knowledge of the OAR. The instrument used was investigator-developed, descriptive, and contained 11 written BAT scenarios based on assessment criteria contained within the OAR. The tool was validated for content, including review by a panel of two experts. The selected sample was randomized to permit adequate representation of specialties in the fields of nurse practitioner and physician assistant. Human subjects were protected through the use of anonymous responses.

## CHAPTER FOUR: ANALYSIS OF DATA

### Introduction

The purpose of this study was to determine if the Ottawa Ankle Rules (OAR), or other clinical information, tests or rules are being utilized by active-duty United States Air Force (USAF) nurse practitioners (NPs) and physician assistants (PAs) to determine fracture in cases of blunt ankle trauma (BAT). This chapter describes the sample, including size, and presents the data obtained by the research questionnaire including responses to 11 case scenarios by study participants.

This study consisted of a descriptive design, comparing NP and PA use of the Ottawa Ankle Rules to evaluate a common clinical phenomena. The questionnaire (Appendix A) was developed by the author to identify factors having a potential impact on the phenomena of BAT. The study sample consisted of two groups of providers, NPs and PAs.

### Sample

Following Uniformed Services University review and Air Force questionnaire approval (Appendix C and D), 56 questionnaires were mailed on 4 October 1998 to a sample drawn from a roster of NPs and PAs with stateside assignments. A total of 28 primary care/adult/family NPs were on this roster as of 1 August 1998. In addition, 28 physician assistants were randomly selected from a total PA population of 220 using a list of random numbers (Burns & Grove, 1997).

The sample was selected from a list obtained through The Freedom of Information Act from Headquarters, Air Force Personnel Center/MSIMD, Randolph Air Force Base, Texas. Security issues precluded a worldwide USAF sampling opportunity (See

Appendix E). Participants receiving a questionnaire mailing were located in 11 of the 12 TRICARE service regions. Region 11 (Washington, Oregon) was not represented, as no respondent from that region was selected due to the random sample. Since respondents were not identified it could not be determined if those returning the questionnaires had differing characteristics from nonrespondents. A follow-up letter was mailed 19 October 1998 (Appendix F). As a result, one NP telephoned the investigator to request a copy of the questionnaire due to loss of the original questionnaire.

A 57% response rate was obtained with the return of 32 completed questionnaires. Data were useable from 29 questionnaires: 18 NPs and 11 PAs. One questionnaire was not used due to provider status (civilian NP), and one was undeliverable (NP). A third questionnaire was not used because the respondent was no longer in the Air Force (PA). Data were summarized for all the variables on the questionnaire. They are discussed in the following sections of the chapter.

### Demographics

Table 3 summarizes the demographic data obtained from 29 respondents. The total months of job experience for both provider types had a range from three months to over 21 years with a mean of 53 months. All NPs and 10 of the 11 PAs were prepared at the master's degree level, one PA reporting a baccalaureate level of education. No respondents held doctorate degrees.

A majority (86%) of respondents worked in primary/acute care, or family medicine. One PA was an orthopedic fellow and worked in an orthopedic clinic. One PA and one FNP reported working in both an emergency department and primary/family clinic. A

**Table 3****Characteristics of Nurse Practitioner and Physician Assistant Respondents**

| Characteristic                          | Nurse Practitioners (N=18) | Physician Assistant (N=11)      |
|---|----------------------------|---------------------------------|
| Family nurse practitioners              | 15                         | General physician assistants 10 |
| Primary or Adult NPs                    | 3                          | Orthopedic Fellow/PA 1          |
| Months as a Provider                    |                            |                                 |
| Mean                                    | 37.7                       | 80.6                            |
| Median                                  | 15                         | 7                               |
| Range                                   | 3-253                      | 36-156                          |
| Highest Education Level                 |                            |                                 |
| Masters degree                          | 18                         | 10                              |
| Practice Setting                        |                            |                                 |
| Emergency Department                    | 1                          | 1                               |
| Primary Care/Family Health              | 16                         | 9                               |
| Orthopedic clinic                       | 0                          | 1                               |
| Aerospace Medicine / Primary Care       | 1                          | 0                               |
| Assigned Mobility Position (see text)   |                            |                                 |
| Yes                                     | 11                         | 5                               |
| No                                      | 7                          | 6                               |
| Mean number of ankle evaluations/ month | 6.3                        | 13.2                            |

Note: N = Number of respondents.

FNP reported working in aerospace medicine and a primary care clinic. One respondent (NP) did not have x-ray capability at the clinical site.

Respondents had the opportunity for multiple responses in describing military readiness and mobility activities. Data were derived from two statements on the BAT questionnaire (See Appendix A). The two statements were (a) "Are you assigned a mobility position", and (b) "Past deployments (check all that apply)". Fifty-five percent (55%) of respondents were in job positions that included assignment to a mobility position, part of a personnel group deployable on receipt of orders. Respondents' experiences included exercises and/or actual deployments. Nearly 14% of respondents reported participation in both exercises and actual deployments. Over half of respondents reported participation in military missions, mainly exercises (Table 4).

#### Adherence to Ottawa Ankle Rules

The OAR are validated clinical decision rules developed to assist health care providers in their use of plain x-rays when evaluating BAT. This study posed four research questions relating to the use of the OAR. Data regarding two research questions are presented in Table 5: (a) Are the OAR clinical guidelines being used by a sample of USAF nurse practitioners and physician assistants? and (b) What clinical information, tests, or rules are used to determine if fracture is present in written cases of blunt ankle trauma? Participants also responded to the open-ended item on the questionnaire (See Appendix A): "What clinical information and/or tests do you utilize to determine if an x-ray is required in cases of blunt ankle trauma?"

Responses were grouped by physical exam, history, and "other" categories, and ranked by frequency. Only 10% of respondents reported use of the OAR in evaluating blunt ankle trauma. Three physical exam items: The ability to bear weight/ambulate

immediately and in the emergency department, point tenderness in specific locations on the ankle and foot, and discomfort/pain combined, composed 41% of the responses in that category. In the history category, "mechanism of injury" was cited 21 times; 56% of

**Table 4****Participation in Military Missions by Respondents**

| Military Mission | Respondents Participating |                            |
|------------------|---------------------------|----------------------------|
|                  | Number*                   | Percent of Total Responses |
| Exercises        | 14                        | 48                         |
| Restore Hope     | 1                         | 3                          |
| Just Cause       | 1                         | 3                          |
| Gulf War         | 3                         | 10                         |
| Albania/Niger    | 1                         | 3                          |
| None             | 13                        | 45                         |

Note: \*Includes several respondents who participated in more than one mission.

None of the respondents were deployed in support of the Vietnam War or troops currently in Bosnia.

the total responses in this category.

Age was reported as a factor in the decision to x-ray, particularly when the patient was less than 25 years old. The five most frequently mentioned items reported as important to respondents included both physical exam and history items (Table 6). Point tenderness was the "provocative test" mentioned most often. Other provocative tests included (anterior) drawer test, stability (varus/valgus/talar tilt) tests, squeeze test, and/or

Table 5

Clinical Information or Tests Utilized to Determine if X-ray is Required in Blunt Ankle Trauma Cases

| <b>PHYSICAL EXAM</b>                                |    | <b>HISTORY</b>   |    |
|---|----|--|----|
| Number of Times Mentioned                           |    | Number of Times Mentioned                                  |    |
| *Bear Weight/ambulate                               | 19 | Mechanism of injury  | 21 |
| Edema/Swelling                                      | 17 | General previous history-<br>(trauma, surgery/hardware)    | 12 |
| *Point tenderness                                   | 16 | "What's worked so far"                                     | 2  |
| Redness/ecchymosis/hematoma                         | 9  | Prompt return to activity                                  | 1  |
| (Anterior) Drawer test                              | 6  | Type of footwear at time of<br>injury (shoes versus boots) | 1  |
| *Discomfort/pain                                    | 6  | Total  | 37 |
| Range of motion                                     | 6  | <b>OTHER</b>   |    |
| Circulatory (vascular/sensation)                    | 6  | Age  | 3  |
| Stability (varus/valgus/talar tilt)                 | 5  | "Gut feeling"  | 2  |
| Ottawa Ankle Rules                                  | 3  | Unusual presentation                                       | 1  |
| Obvious deformity, or exam<br><i>each with</i>      | 3  | Total  | 6  |
| Squeeze test, or "pop"<br><i>each with</i>          | 2  |  |    |
| Strength, "crack", or "+ grind"<br><i>each with</i> | 1  |  |    |
| Total   | 99 |  |    |

Note: \*Ottawa Ankle Rules criteria from I. Stiell, D. McKnight, et al. 1994, p. 828.

grind test. Of the 24 different items mentioned as important in determining whether or not to x-ray, the history items, mechanism of injury, and previous trauma, composed 89% of all history category responses and 23% of total responses.

Research question three asked: Is there a difference in the selective use of x-rays in case scenarios between NPs and PAs? Respondents were asked to indicate whether or not an x-ray is required for each of 11 case scenarios by selecting "Yes" or "No". Each case was constructed for a "most accurate" response, in an attempt to avoid selection

Table 6

Most-Frequently Mentioned Items as Important to Nurse Practitioner and Physician Assistant Respondents

| Item   | Number of Times Mentioned | Percent of Times Mentioned |
|--|---------------------------|----------------------------|
| Mechanism of injury <sup>1</sup>                               | 21                        | 15                         |
| Ability to bear weight/ambulate <sup>2</sup>                   | 19                        | 13                         |
| Edema/swelling <sup>2</sup>                                    | 17                        | 12                         |
| *Point tenderness <sup>2</sup>                                 | 16                        | 11                         |
| Previous trauma, surgery,<br>or retained hardware <sup>1</sup> | 12                        | 8                          |

Note. \* Provocative test. <sup>1</sup> History category. <sup>2</sup> Physical Exam category

bias. The most accurate selection was "Yes" for cases 1, 3, 5, 7, 9, and 10. "No" was the most accurate selection for cases 2, 4, 6, 8, and 11. Table 7 shows a difference in accuracy between NPs and PAs of only 1%.

Accuracy for specific scenarios were similar for NPs and PAs (see Table 8).

Scenario seven had 100% accuracy for both groups. Both groups had the least accuracy in case 4: only 56% for NPs, and 45% for PAs. NPs had greater accuracy than PAs in

Table 7

Nurse Practitioners and Physician Assistants Accuracy: Frequency of Case Responses

| Provider Type        | Number of Responses |                | % Accurate |
|----------------------|---------------------|----------------|------------|
|                      | Most Accurate       | Least Accurate |            |
| Nurse Practitioners  | 169                 | 29             | 83         |
| Physician Assistants | 103                 | 16             | 84         |

cases 4, 8, 9, and 10. PAs had greater accuracy in cases 1, 2, 3, 5, 6, and 11. NPs were 100% accurate in case 7. PAs were 100% accurate in cases 1, 3, 5, 6, and 7. When comparing accuracy, the two groups NPs and PAs, appear clustered. Cases 1, 2, 5, 7, 8, 9, 10, and 11 were equal in accuracy to 6% or less difference between groups. Cases 3, 4, and 6 differences between the NPs and PAs ranged from 11 to 17% accuracy. Scenario responses from both groups were combined to determine overall respondent accuracy (See Table 9).

The fourth research question asks: Is there a theoretical financial benefit to using the Ottawa Ankle Rules? Respondents inaccurately indicated they would obtain x-rays in 36 of the possible 145 times it would have been most accurate not to obtain an x-ray. A total of 36 unnecessary x-ray procedures would be quite costly. The cost of a single x-ray, based on dollar-value obtained from one USAF medical center located in TRICARE Region One, Northeast is \$35.92, including interpretation costs (B. Cunningham,

TRICARE /MEPRS, personal communication, 22 December, 1998). When 36 unnecessary x-rays are multiplied by the per unit cost, this total is \$1,293. Often, more

Table 8Percent Accuracy in 11 Blunt Ankle Case Scenarios by Provider

| <u>Scenario Number</u> | <u>Nurse Practitioners</u> | <u>Provider</u><br><u>Physician Assistants</u> |
|------------------------|----------------------------|--|
| 1                      | 95                         | 100  |
| 2                      | 89                         | 91   |
| 3                      | 83                         | 100  |
| 4                      | 56                         | 45   |
| 5                      | 94                         | 100  |
| 6                      | 89                         | 100  |
| 7                      | 100                        | 100  |
| 8                      | 83                         | 82   |
| 9                      | 95                         | 90   |
| 10                     | 95                         | 90   |
| 11                     | 61                         | 64   |

than one x-ray view will be required. Pfeffer (1998) reports "AP [anterior-posterior], lateral, and oblique (slightly internally rotated AP) radiographs will show most fractures...Minimally displaced fractures may not appear on initial radiographs; therefore, radiographs should be repeated in 10-14 days, if there is a high suspicion of a

fracture" (p. 425). If the total unnecessary cost is multiplied by three (the average number of initial x-rays per BAT episode), the cost becomes \$3,879, a significant amount indeed.

Table 9Nurse Practitioners and Physician Assistants Combined Accuracy by Blunt AnkleTrauma Case Scenario

| Scenario Number                       | Number of Respondents | Percentage |
|---------------------------------------|-----------------------|------------|
| <u>Accurate to order an x-ray</u>     |                       |            |
| 1                                     | 28                    | 97         |
| 3                                     | 26                    | 90         |
| 5                                     | 28                    | 97         |
| 7                                     | 29                    | 100        |
| 9                                     | 26                    | 93         |
| 10                                    | 26                    | 93         |
| <u>Accurate to not order an x-ray</u> |                       |            |
| 2                                     | 25                    | 86         |
| 4                                     | 15                    | 52         |
| 6                                     | 27                    | 93         |
| 8                                     | 24                    | 83         |
| 11                                    | 18                    | 62         |

Verbeek and colleagues (1994) retrospectively reviewed 123 sets of emergency department ankle x-rays to determine if three views were needed. They concluded "The mortise and lateral views are sufficient for diagnosing ankle fractures instead of the standard AP, lateral, and mortise views. . . . and imply a substantial decrease in radiation and cost savings to the patient" (p. 172). Thirty-six unnecessary x-rays tests, multiplied by two (2 views), then by \$35.92 yields a theoretical benefit of \$2,586 for initial diagnostic x-rays only.

### Summary

The purpose of this study was to determine if the Ottawa Ankle Rules or other clinical information, tests or rules are being utilized by active-duty USAF nurse practitioners and physician assistants to determine fracture in cases of blunt ankle trauma. This chapter presented a discussion of characteristics of respondents, and data on the four research questions.

The variables included in the questionnaire elicited data pertaining to the Air Force NPs and PAs characteristics, clinical practice setting, and clinical information/tests utilized to determine if an x-ray test is required in cases of BAT. The clinical BAT scenarios evaluated the respondent's accuracy in determining if an x-ray was required. Costs of unnecessary x-rays were estimated. Accuracy of NP and PA respondents was shown for the 11 test scenarios used in the study.

Chapter five will provide a further discussion of the study data and make recommendations for further research. Implications for military medical readiness, education, and fiscal resources will also be discussed.

## CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Introduction

The ankle is the most frequently injured joint in the body and, as such, ankle trauma is a common presentation in North American emergency departments (EDs). Weinstein (1993) estimates that 1 million people present to EDs and acute care clinics each year with blunt ankle trauma (BAT), with 95% receiving an x-ray. Of the over 6 million radiographic series performed each year for ankle trauma, only 14 to 20% will demonstrate a fracture (Clark et al., 1995; Stiell, 1994; Stiell, Greenberg, et al., 1992; Stiell, McDowell et al., 1992; Verma et al., 1997), and represents a cost to the United States and Canada of  $\frac{1}{2}$  billion dollars (\$500,000,000) (Stiell, 1996).

The purpose of this study was to determine if the Ottawa Ankle Rules (OAR), or other clinical information, tests or rules are being utilized by active-duty, Air Force nurse practitioners (NPs) and physician assistants (PAs) to determine if x-ray is required in cases of BAT. Methodology consisted of developing a tool that included demographic variables and case scenarios developed using the OAR criteria. A panel of two content experts reviewed the questionnaire for content validity to minimize systematic error (Appendix A). Specific instructions for evaluating each item and the total instrument were given to the experts. The instrument yielded a content validity index of 0.93, providing supporting evidence for the validity of the tool. No pilot study was conducted. Data were obtained from 29 of 32 returned questionnaires, a return rate of 57%.

### Conclusions

#### Sample

The entire population of United States-assigned (CONUS) NPs (adult, family,

primary care) were selected to represent those who were likely to see non-pregnant, adult, primary care patients. The PA sample was randomly selected in order to a select a representative group equal in size to that of the NP sample. The questionnaires were mailed to 100% of CONUS adult, family and primary care NPs in particular Air Force specialty codes (*AFSCs*- 46N1H, 46N3H, 46N1C, & 46N3C) and to 28 of the total 220 PAs not working in the orthopedic, otolaryngology or perfusionist specialties (*AFSCs*- 42G1, & 42G3) on the CONUS list. With this sample selection method, it could be said that members of each of these groups did not have an equal opportunity for selection in the study. The return rate of nearly 60% compares favorably to return rates obtained by mailed questionnaires.

In the past five years, the USAF medical service has increased the utilization of family NPs (FNPs). Their numbers were well represented in the NP sample: 15 of the 18 NPs were FNPs. The NP return rate was 64%. The PA group return rate was 39%. The follow-up mailing was an economical method to boost the rates of questionnaire return. The actual impact of the follow-up mail reminder was not assessed. The USAF point of contact ensured the alpha roster was current within one calendar quarter and inclusive for the study criteria, a strength of the study. Due to the overall low return rate, generalizability of the findings is limited.

Nurse Practitioners and physician assistants reported similar deployment rates, assignment against mobility slots, and exercise rates. In this regard, respondent duties appear to have clinical and educational similarities despite being in different provider categories. Both groups of respondents worked in primary care settings, had an average of over two years experience and were prepared through graduate education. Use of the

OAR by both groups could improve the effective use of x-rays from the 75% specificity noted in this study to the near 100% cited in the literature.

### Demographics

A majority (86%) of the well-educated respondents worked in primary/acute care, or family medicine areas. One respondent indicated an inability to access x-ray technology on site. X-ray technology is commonplace in most CONUS practice settings. Only the most austere of practice environments would not provide x-ray capability. Perhaps the respondent misinterpreted the question.

The difference in average time as a provider between the NPs or PAs was a notable finding. The PAs average time as provider was nearly seven years compared to the NPs clinical experience of just over three years. This difference was also evident in the reported number of ankle evaluations per month. The NPs reported evaluating over six ankles per month while the PAs reported an average of over 13 evaluations per month. These estimates may reflect recall, experience levels, practice setting, and/or the degree of confidence in evaluating cases of BAT. The dearth of NP and PA respondents reporting work in emergency departments (EDs) was noted. This may be because participants do not work in this area or the time constraints of personnel working in this area prevented them from completing and returning the questionnaire. Hence NPs and PAs working in CONUS EDs may be underrepresented.

Lieutenant General Anderson, a recent former AF Surgeon General (AF/SG), was known by his motto “readiness is job one”. The study reported 61% of NP and 83% of PA respondents were assigned against mobility positions. Nearly half (48%) of the respondents reported experience with readiness exercises. Six (21%) respondents

reported actual involvement with named deployments. Nearly half (45%) of the respondents reported neither readiness exercise involvement nor mission deployment.

### Research Questions

Most ankle injuries occur following excessive hyper-dynamic movement or BAT. The four research questions sought to determine what clinical information, tests or rules are utilized to expedite assessment and management of ankle injury and whether or not x-rays were required.

Research question one. The first research question asked what information, tests or rules are used to determine if fracture is present in cases of BAT. Results indicate respondents may have answered this item as if they were performing a complete ankle evaluation. Respondents reported considerable use of history items, particularly mechanism of injury. Mechanism of injury is very important, but if the injury occurred rapidly, or while focusing on a task or activity, the patient may not know exactly how the injury occurred (Trevino et al., 1994).

The respondents did not mention time of injury as being important. Nor did they mention the time interval between injury and evaluation. Trojan and McKeag (1998) discuss office evaluation and the importance of the golden period in ankle assessment. This period is shortly after the injury and there "is no swelling, the initial pain has subsided, and guarding is not yet present- all of which facilitate a fruitful exam" (p. 30). Combined with a well-thought out history, prompt evaluation "can lead to proper diagnosis most of the time" (p. 31) even if the patient cannot recall the mechanism of injury.

Physical exam items constituted the majority of responses to this item. No respondents mentioned examining the unaffected contralateral limb first as a useful reference point and to reduce patient anxiety. Respondents may have assumed this item as a basic part of the evaluation process. Edema/swelling was mentioned more often than point tenderness and less than the ability to bear weight/ambulate. Edema tends to have a splinting effect on the ankle joint complex. Clarke and colleagues (1995) suggest that the presence of ankle effusion on plain radiographs may be suggestive, or may hide an underlying fracture. Air Force primary care clinicians have the capability of referring BAT patients for complex-motion tomography as was performed by Clarke and colleagues. In a field or combat setting, clinicians must rely on clinical evaluation, with less than 100% access to plain-film x-ray equipment.

Foot and ankle injuries have a severe impact on the health of military personnel and mission requirements of AF airmen. Fleming's (1988) Army study looked at lower-extremity injuries. Ankle sprain was the most prevalent injury to the combat soldier. Gebbie (1997) has pointed out "the vision of health...will be ensuring that people receive the care they need" (p. 88). The goal of the field-assigned FNP or PA requires an emphasis on early determination of fracture, and a quick return of motion, strength, and proprioception. Miller and Hergenroeder (1990) report that from 36 to 72 days may be required for complete rehabilitation from ankle sprain alone. An accurate, timely diagnosis ruling out significant fractures would facilitate a quicker return to full duty with reduced morbidity.

Of the numerous provocative tests mentioned as helpful, point tenderness was mentioned most often. Responses indicate a reliance on range of motion, anterior drawer

test, and stability tests (varus/valgus/talar tilt) almost equally. The ability to bear weight, point tenderness and pain have been incorporated into the Ottawa Ankle Rules. Stiell, Greenberg and colleagues (1992) developed these criteria based on the reliability and significant fractures associated with 32 clinical variables. The OAR have subsequently been validated in several large, studies (Auleley et al., 1997; Lucchesi et al., 1995; McBride, 1997; Pigman et al., 1994; Salt, & Clancy, 1997; Verma et al., 1997) and is better than clinical suspicion alone in detecting fracture (Lucchesi et al., 1995).

Research question two. Research question two asks if the OAR is being used. Three respondents mentioned use of the rules. The OAR help guide ordering of radiographs for acute ankle and midfoot injuries. However, the rules cannot be applied if the NP or PA cannot palpate the bone because of excessive swelling. The OAR, if properly applied will have a sensitivity of nearly 100% (Verma et al., 1997). The use of the OAR as a clinical guideline when considering referral to the x-ray department will influence the number of x-rays requested by the department. Introduction of a clinical guideline such as the OAR would be primarily educational to develop an optimal strategy for the diagnosis of a common problem.

Graham (1998) reports that the OAR as clinical decision rules has gained acceptance in Canada, and are in use by 95% of respondents in a recent survey of ED physicians in that country. The respondents in that randomly selected sample survey tended to be of younger age, have fewer years since graduating from medical school, and believed that decision rules are not oversimplified cookbook medicine or too rigid to apply. Nearly 100% of respondents from Graham's study would consider using validated clinical

decision rules when evaluating whether or not to x-ray ankle trauma, knee trauma, or use computed tomography of head and cervical spine in head injury.

Salt and Clancy (1997) report nurses were able to apply the OAR without missing a fracture in one acute and emergency department of an English university teaching hospital. In this study, one of six senior nurses evaluated ankle trauma following instruction and use of a pocket card. Patients received subsequent physician evaluation. Of the 86 patients not sent for x-rays by the nurse, 19 had x-rays ordered by the physician, who was similarly instructed in the use of the OAR. None of these 19 patients demonstrated fracture. Of the 67 patients receiving an instruction sheet and no x-ray, none returned in the subsequent eight weeks.

Research question three. A third research question asks if there is a difference in the selective use of x-rays between NPs and PAs as measured by responses to written case scenarios. Non-physician providers are being used in greater numbers by the AF medical service. Historically, PAs have been in service longer, and in greater numbers than NPs. Following the current national trend to prepare nurses for primary care, the AF has funded increasing positions for graduate education as a NP. Experience as a provider and mean time as a provider did not have an impact on overall ability to determine if x-ray was required in the case scenarios. Nurse practitioners were accurate in 83% of cases whereas PAs had an accuracy rate of 84%. The PAs reported examining over twice as many ankle injuries per month as compared with NPs. This data indicates experience may not necessarily be correlated with accuracy as measured by the written scenarios.

There was a difference in the accuracy rate between NPs and PAs of 6% or less in eight of the 11 case scenarios. Among these eight cases, better accuracy was split

equally, with each group answering four of the eight cases with greater accuracy than the other group. In one case, NPs and PAs both answered with 100% accuracy each. In the three remaining cases accuracy between groups varied 11 to 17%. The NPs were 100% accurate in one case. The PAs were 100% accurate in five cases. Clinical experience among respondents within each group may have been a factor in differences among and between cases, and between providers, although results may be affected by whether respondents completed the questionnaire alone or sought out assistance, or perhaps worked together on multiple questionnaires. This factor may explain the relatively low accuracy of NPs and the 100% accuracy by PAs in case 3.

Case 4 and 11 had the lowest accuracy rates for both NPs and PAs. Dr. Stiell (personal communication, July 17, 1998) in his expert review of the questionnaire, considered these cases “slightly irrelevant” and “unlikely” since “Normally a clinician would only test the ability to bear weight if no tenderness. You ask more difficult questions to determine comprehension of ‘ability to bear weight.’” Dr. Stiell’s comments presume there would be pain in the malleolar zone if you had either medial or lateral tenderness. Based on Dr. Stiell’s input, the statement “able to bear weight” was added to each of these cases to make these particular scenarios more realistic. In these two cases, it would appear that “bone tenderness” without “pain” suggest an x-ray should be ordered inaccurately by approximately half of all respondents; presumably to aid in diagnosis. In these two cases, more clinical information may have been sought, or the terms “bone tenderness” and “pain” may have been considered synonymous.

Research question four. The final question asks if there is a theoretical financial benefit to using the Ottawa Ankle Rules. This study reported a significant estimated

dollar savings if OAR are utilized to evaluate BAT when only the cost of x-ray was considered. The average cost of BAT ranges from \$300-\$900 for diagnosis and rehabilitation (Weinstein, 1993). Stiell (1996) estimates \$500,000,000 is spent annually on ankle radiography in the United States and Canada. Rigler (1976) feels the true monetary cost lies with the usage of other consultants or other radiologists after x-rays are obtained.

The theoretical cost of an x-ray for this study was determined using information from a single East Coast AF medical center. The theoretical cost benefit is similar to other studies and economic analysis concerning x-ray use in ankle injury episodes (Michelson et al., 1995; Squillace & Slawson, 1994; Stiell et al., 1995; Stiell, McKnight, et al., 1994). Study findings support a conclusion that using OAR as part of a complete evaluation of BAT by non-physician providers would result in substantial cost saving.

#### Recommendations

Improving quality while containing costs is arguably one of the highest priorities in the AF medical service today. The development of practice guidelines such as the OAR, began recently in medicine. Wasson and Sox (1996) suggest that the objective of clinical prediction rules is to reduce the uncertainty inherent in medical practice by defining how to use clinical findings to make predictions. Use of the OAR by NPs and PAs will support outcome measures that show that these clinicians provide competent and efficient health care resulting in overall cost savings and better care. These validated rules guide practice and have the potential to increase the safe use of judicious ankle radiography, decrease waiting times, and reduce overall costs as AF health care moves into the 21st century.

Use of the OAR in the field and office setting would decrease evaluation time, offer a greater degree of confidence in diagnosis, and ensure the safe return of airmen to duty more quickly. Readiness and mobility training and/or assignments are an inherent part of military practice as reported in the study. The OAR demonstrate proven benefits and would be a helpful tool in the field, by conserving technology and bolstering diagnostic confidence in austere conditions.

Practice guidelines historically have been under-disseminated (Woolf, 1992). No type of guideline is inherently effective, particularly if used in isolation. Collaborative education programs (in-service scale) for all types of providers could be instituted that allow for a value-added skill used in encounters with BAT patients in military treatment facilities (MTFs) and in the field. Greco and Eisenberg (1997) suggest that many providers are reluctant to change practice even when randomized trials demonstrate effectiveness.

An education process on the OAR, or feedback as to how an individual practice compares to that of peers, can positively affect patient outcomes. By observing the OAR being used in practice, clinicians may well adopt this simple, safe, and helpful tool. Written case scenarios as used in this study may prove beneficial in training clinicians in the use of the OAR. Standardized pocket cards are available as well as a poster describing the OAR for a nominal fee. Instruction would take less than 30 minutes, and as part of a recurring staff meeting, receive widest local dissemination. Administrative assurance of this quality improvement intervention would detail positive outcomes and “best” tests are used in the evaluation of BAT. Use of the OAR could be taught utilizing a case scenario method as in this thesis. Education of the OAR utilizing written or

moulage scenarios would enhance war skills training and the readiness of military health care providers in preparing for operations other than war or care in other field conditions. In this unique setting, prompt, accurate determination of duty abilities is vital.

Clinical guidelines began as a form of education and are becoming a part of the standard of practice in many practice arenas (Greco & Eisenberg, 1997). The study reported in this thesis demonstrated that a majority of NPs and PAs were unaware of the OAR. In patient encounters, the prudent provider determines patient expectations and provides information on the disease process. An educational pamphlet used during BAT encounters would serve to educate the patient as to why x-rays were done (or not done). This educational sheet could include follow-up instructions including when to return for re-evaluation.

Replication of this study at Air Force MTFs would provide a description of provider demographics and determine knowledge of BAT evaluation. A further recommendation would be to randomly place the “yes” or “no” case scenarios within the instrument to eliminate guesswork bias. Replication with respondents from each TRICARE region may reveal geographic differences in the way BAT cases are evaluated. A retrospective study of MTF records might reveal slippage in the documentation of BAT assessment (point tenderness or ability to bear weight) or overuse of x-rays in “real” cases, justifying a trial of the OAR. The OAR are safe and effective to use in conjunction with a complete evaluation process.

### Summary

This descriptive study demonstrated the abilities of NPs and PAs to determine if an x-ray was required in written cases of BAT with near-equal accuracy. Unique

demographic aspects of a military sample of NPs and PAs were shown. Mobility and mission readiness are aspects unique to military health care providers. Respondents reported participation in these activities. Respondents generally did not recognize the OAR as a helpful guide in the determination of whether or not to obtain an x-ray when evaluating blunt ankle trauma. Accuracy in the decision to x-ray in cases of BAT would be improved through correct and consistent use of the Ottawa Ankle Rules. Local clinical trials would facilitate adoption of the OAR as a standard of practice in cases of BAT.

Providers in the MTF, working in primary care or acute settings, may be unaware of the OAR. In this case, a brief educational intervention is recommended using standardized products. Military leaders recognize the importance of satisfied customers. Leaders direct military clinical care amidst a paradigm shift that has taken centuries to develop. The neglect of military personnel in the past has given way to federally-mandated concern for military members and their families (Roark & Tucker, 1997). Provider values concerning health care and the beneficiary expectations are changing in line with economic realities. Widest use of the OAR within the AF medical service by NPs and PAs will improve customer service by decreasing waiting times, and lowering treatment costs within the clinical service. Time saved can be utilized in educating the sophisticated beneficiary during the encounter. Education is a “value-added” item ultimately bringing about positive change in the AF medical service.

The positive reasons for supporting clinical guidelines like the OAR outweigh any negative ones. Use of the OAR would bring order and some measure of predictability to the evaluations of BAT. Even more compelling, it could lead to a more satisfying

relationship with our patients. It is possible for personal and societal values to be weighed while health care decisions are made. Nurse practitioners and physician assistants have an opportunity to use a simple guideline, making it part of the standard of practice in evaluating blunt ankle trauma.

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## APPENDICES

Appendix A. Blunt Ankle Injury Questionnaire

Appendix B. Blunt Ankle Injury Codex

Appendix C. Uniformed Services University of the Health Sciences

IRB Review and Approval of Protocol T06182 for Human Subject Use

Appendix D. United States Air Force Survey Approval Letter

Appendix E. HQ AFPC/MSIMD Listing Letter

Appendix F. Follow-up Mailer Example

Appendix G. Permission to Use Ottawa Ankle Rules

Appendix H. Consent Form

**APPENDIX A: Blunt Ankle Injury Questionnaire**

Appendix A

## BLUNT ANKLE INJURY QUESTIONNAIRE

Approved: USAF SCN 98-52

### PERSONAL INFORMATION (Please check those that apply)

Nurse Practitioner (NP)  AFSC \_\_\_\_\_

Physician Assistant (PA)  AFSC \_\_\_\_\_

How long as a PA or NP? (months) \_\_\_\_\_

Education level: Bachelor's  Certificate  Master's

PhD  Other  (Describe): \_\_\_\_\_

Practice setting (Check One): Non-clinical  Primary Care

Emergency Department  Other  (describe) \_\_\_\_\_

---

Are you assigned to a mobility position? YES  NO

### Past deployments (check all that apply)

Vietnam War  Gulf War  "Restore Hope"

"Just Cause"  Bosnia  Exercises

Other Describe: \_\_\_\_\_

How many ankle injuries do you treat in a month? (specify number): \_\_\_\_\_

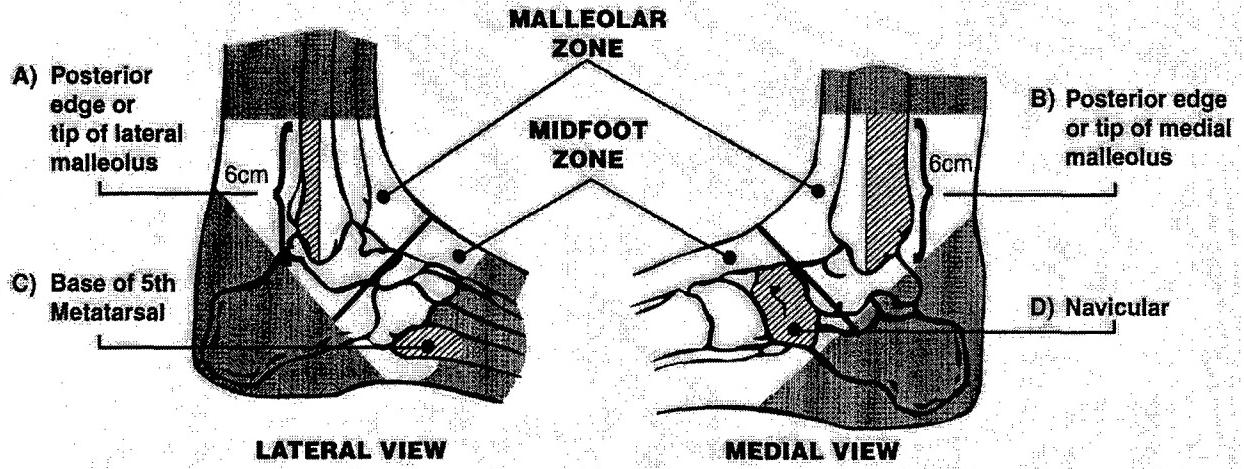
Do you have X-RAY capabilities in your current practice location? YES  NO

What clinical information and/or tests do you utilize to determine if an x-ray test is required in cases of blunt ankle trauma?

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(Continued on page 3)



### Diagram to accompany the Blunt Ankle Injury Questionnaire

Used with permission (1998).

William A. Novak

## BLUNT ANKLE INJURY QUESTIONNAIRE

\*For each case below, utilize the diagram on page 2.

-Each of the following patients:

- present in the clinic with acute, non-bleeding ankle injury.
- is not pregnant and over 18 years of age.
- present for the first time in the ambulatory setting and,
- has no cognitive or sensory impairment.

### WOULD YOU ORDER AN X-RAY FOR EACH OF THESE PATIENTS BASED ON THE FOLLOWING PHYSICAL EXAM?

1. Pain in the malleolar zone AND bone tenderness at the posterior edge or tip of the lateral malleolus

YES  NO

2. Pain in the midfoot zone AND no bone tenderness at the navicular bone, able to bear weight both immediately and in the clinic

YES  NO

3. Pain in the malleolar zone AND bone tenderness at the posterior edge or tip of the medial malleolus

YES  NO

4. No pain in the malleolar zone, AND bone tenderness at the posterior edge or tip of lateral malleolus; able to bear weight

YES  NO

5. Pain and tenderness in the midfoot zone AND inability to bear weight both immediately and in the clinic

YES  NO

6. Pain in the malleolar zone AND able to bear weight both immediately and in the clinic, without bone tenderness

YES  NO

7. Pain in the midfoot zone AND bone tenderness at the base of the 5<sup>th</sup> metatarsal

YES  NO

8. Pain in the midfoot zone AND no bone tenderness at the base of the 5<sup>th</sup> metatarsal, able to bear weight both immediately and in the clinic

YES  NO

9. Pain and tenderness in the malleolar zone AND inability to bear weight both immediately and in the clinic

YES  NO

10. Pain in the midfoot zone AND bone tenderness at the navicular bone

YES  NO

11. No pain in the malleolar zone AND bone tenderness at the posterior edge or tip of the medial malleolus; able to bear weight.

YES  NO

**Thank you for your responses. Please place both pages in the self-addressed, stamped envelope and mail.**

**APPENDIX B: Blunt Ankle Injury Codex**

Appendix B  
Codex for Blunt Ankle Trauma.

|                              |    |  |
|------------------------------|----|--|
| <u>Nurse Practitioner</u>    |    | <u>Number of ankle injuries/month:</u> = $\chi$  |
| Adult                        | 1a |  |
| Primary care                 | 1b | <u>X-ray capability at facility</u>  |
| Family                       | 1c | YES 7a<br>NO 7b  |
| AFSC (verbatim)              |    |  |
| <u>Physician's Assistant</u> |    | <u>What clinical information, tests, and/or rules do you utilize to determine if an x-ray test is required in cases of blunt ankle trauma?</u> |
| General duty                 | 2a |  |
| Orthopedic                   | 2b |  |
| General surgery              | 2c |  |
| AFSC (verbatim)              |    |  |
| <u>How long: x months</u>    |    | Verbatim recording   |
| <u>Practice Setting</u>      |    | <u>Case Studies:</u>   |
| Non-Clinical                 | 3a | Case YES NO  |
| Primary Care                 | 3b | 1 8a1 8b1  |
| ED                           | 3c | 2 8a2 8b2  |
| Other                        | 3d | 3 8a3 8b3  |
|                              |    | 4 8a4 8b4  |
|                              |    | 5 8a5 8b5  |
|                              |    | 6 8a6 8b6  |
| <u>Education Level</u>       |    |  |
| Bachelor                     | 4a | 7 8a7 8b7  |
| Certificate                  | 4b | 8 8a8 8b8  |
| Master's                     | 4c | 9 8a9 8b9  |
| PhD (doctorate)              | 4d | 10 8a10 8b10   |
| Other (describe)             | 4e | 11 8a11 8b11   |
| <u>Mobility</u>              |    |  |
| YES-                         | 5a |  |
| NO-                          | 5b |  |
| <u>Past deployments:</u>     |    |  |
| Vietnam War                  | 6a |  |
| Gulf War                     | 6b |  |
| Restore Hope                 | 6c |  |
| Just Cause                   | 6d |  |
| Bosnia                       | 6e |  |
| Readiness Exercises          | 6f |  |
| Other (described)            | 6g |  |
| None checked                 | 0  |  |

APPENDIX C: Uniformed Services University of the Health Sciences IRB Review and  
Approval of Protocol T06812 for Human Subject Use

## Appendix C

July 29, 1998

MEMORANDUM FOR CAPT WILLIAM A. NOVAK, GRADUATE SCHOOL OF NURSING

SUBJECT: IRB Review and Approval of Protocol **T06182** for Human Subject Use

Your research protocol, entitled "*Use of Ottawa [sic] Ankle Rules to Evaluate Blunt Ankle Trauma Case Studies by USAF Health Care Providers*," was reviewed and approved for execution on **July 28, 1998** as an exempt human subject use study under the provisions of **32 CFR 219.101(b)(2)**. This approval will be reported to the full IRB, scheduled to meet on August 13, 1998.

The IRB understands that this study uses a questionnaire sent to eighty randomly chosen Air Force physician's assistants to obtain data on principles behind treatment decisions about hypothetical ankle injuries. The data will then be compared to treatment guidelines set out in the *Ottawa [sic] Ankle Rules*. None of the information collected will be traceable to any individual subject, and only aggregates will be reported.

Please notify this office of any amendments or changes in the approved protocol that you might wish to make and of any untoward incidents that may occur in the conduct of this project. If you have any questions regarding human volunteers, please call me at 301-295-3303.

-Signed-

Richard R. Levine, Ph.D.  
LTC, MS, USA  
Director, Research Programs and  
Executive Secretary, IRB

APPENDIX D: United States Air Force Survey Approval Letter

Appendix D

7 July 1998

MEMORANDUM FOR CAPTAIN NOVAK

FROM: HQ AFPC/DPSAS  
550 C Street West Suite 35  
Randolph AFB TX 78150-4737

SUBJECT: USAF Control Number (Your e-mail, 7 July 1998)

Your proposed "Blunt Ankle Injury Questionnaire" has been reviewed and is assigned a Survey Control Number (SCN) of USAF SCN 98-52. This number and authorization will expire on 31 December 1998.

With regard to the survey and its associated results, it is important to draw your attention to the provisions of the Freedom of Information Act (FOIA). Under the FOIA, the results of your survey can be requested by the public. Additionally, please forward a copy of the final version of the survey for our files. Finally, the SCN needs to appear either in the cover letter or on the face of the survey itself.

Questions or concerns can be directed to me or Mr. Hamilton at (210) 652-5680. Thank you and good luck with your data collection efforts.

-Signed-

MICHAEL J. BENSON, Lieutenant,  
USAF  
Personnel Survey Analyst

APPENDIX E: HQ AFPC/MSIMD Listing Letter

## Appendix E

20 Aug 1998

HQ AFPC/MSIMD  
550 C Street West Suite 48  
Randolph AFB TX 78150-4750

Captain William A. Novak, USAF  
Uniformed Services University  
4028-1 Ashwood Circle  
Andrews AFB MD 20762

Dear Captain Novak,

This is in response to your Freedom of Information Act (FOIA) request (#98-0681) of 13 Jul 98. The attached listing consists of releasable information on active duty Air Force nurse practitioners and physicians assistants, but excludes personnel assigned overseas, or in classified, sensitive, or routinely deployable units. The list also includes the eight nurse practitioners who returned to active duty from USUHS last spring.

Under Department of Defense 4525.8 – Manual/Air force supplement, “Official Mail Manual,” dated 18 April 1994, the Base Information Transfer System will not deliver unofficial mass mailings addressed to individuals at the duty address. We define a mass mailing as 50 or more pieces of mail received on the same day from the same mailer. In this context, unofficial mail is mail addressed to an individual that does not have an official return address from a government agency. The 1996 Mail Reclassification requires a full street address which our present system does not contain.

Sincerely

DARRELL VEGA, A1C, USAF  
Information Lifecycle Mgt, FOIA, PA Technician

APPENDIX F: Follow-up Mailer Example

## Appendix F

### Follow-up Mailer Example

Graduate School of Nursing, Student mailbox #849  
4301 Jones Bridge Road  
Bethesda, MD 20034

#### **BLUNT ANKLE INJURY QUESTIONNAIRE**

Thanks in advance for completing and returning the survey I recently mailed to your business address under your name. If you did not receive this survey, contact me by phone and I'd be happy to provide a second copy. Rest assured your responses are completely confidential.

If you have any questions, please don't hesitate to call :  
(301) 599-0675.  
Captain Bill Novak, USAF, NC  
FAMILY NURSE PRACTITIONER PROGRAM

Graduate School of Nursing, Student mailbox #849  
4301 Jones Bridge Road  
Bethesda, MD 20034

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FAMILY NURSE PRACTITIONER PROGRAM

APPENDIX G: Permission to Use Ottawa Ankle Rules

## Appendix G

### Permission To Use Ottawa Ankle Rules

From electronic mail received 20 April, 1998

Subj: Re: Permission: Request Grad student use of Ottawa Ankle Rules

Date: 98-04-20 09:54:28 EDT

From: <istiell @lri.ca> (Ian Stiell MD)

To: <Novbike @aol.com> (Novbike)

Dear Mr. Novak

You certainly may have my permission to use the OAR in your thesis study. The figure is fixed and I am uncomfortable when people attempt to "alter" how the oar is depicted. I would appreciate seeing exactly how you plan to use the OAR.

Good luck with your study.

Return-Path <istiell @lri.ca>

APPENDIX H: Consent Form

Appendix H  
Consent Form

**Purpose.** This research study is to describe the clinical information, tests or rules United States Air Force (USAF) health care providers use to evaluate written cases of blunt ankle trauma.

**Investigator:** William A. Novak, Captain, USAF, NC

Uniformed Services University of the Health Sciences (USUHS)

Graduate School of Nursing, Department of Family Nurse Practitioner

4301 Jones Bridge Road

Bethesda, Maryland 20034

Investigator USUHS Mail Box: GSN #849

Home: (301) 599-0675

Office: (301) 295-1992

**Condition for Participation.** You must be an active duty Adult/Primary Care/Family Nurse Practitioner or Physician Assistant in the USAF during the survey period.

**Procedure/Tasks.** Each participant is asked to complete the accompanying three page Blunt Ankle Injury Questionnaire and return it to the investigator via mail return of the questionnaire in the self-addressed, postage-paid envelope provided.

**Risk/Benefit.** This study involves no physical risk or discomfort to you. While this study may not help you personally, it may help USAF providers determine what information is required to make a decision to x-ray in cases of blunt ankle trauma. If you have any questions about your participation in this study, please contact the investigator or the Office of Research at USUHS phone: (301) 295-3303.

**Confidentiality.** Any information obtained will be kept strictly confidential and protected to the fullest extent of the law. Information you provide and records related to this study will be accessible only to the investigator, USUHS Institutional Review Board and other Federal agencies providing oversight for human use protection. You have the right to withdraw from the study at any time. You have the right not to answer any or all of the questions. Please do not write any identifying information such as name, phone number, address, or social security number on the questionnaire.

**Cost.** Your participation is appreciated. There is no cost to you for your participation in this study. You will not receive any monetary reimbursements or rewards for your participation.

**Information from the investigator.** The investigator will be happy to answer any questions regarding this study. This study is sponsored by USUHS, Bethesda, Maryland. The results of the study will be available through the Graduate School of Nursing, Nursing Research Department.

**Consent.** To maintain anonymity, completion and return of this questionnaire implies consent for inclusion in the study.

THANK YOU FOR YOUR PARTICIPATION.